

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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COMMUNICATIONS DIVISION
FEDERAL COMMUNICATIONS COMMISSION

In the Matter of)


Advanced Television Systems)
and Their Impact Upon the)
Existing Television Broadcast)
Service)


MM Docket No. 87-268

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Motorola is pleased to submit these Comments in response to
the Commission's proposal in the above-captioned proceeding. These
comments were originally due November 15, but could not be filed because
the Commission was closed.

Respectfully Submitted,


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Executive Summary

Motorola applauds the FCC for recognizing that delivery of advanced television (ATV) does not prevent redevelopment of some portion of the 400 MHz of spectrum currently allocated for over-the air television. At best, only 30% of this 400 MHz allocation is used today for the actual delivery of broadcast service to the public. Also, consumers have access to an increasing number of alternative “pipelines” over which to receive entertainment. At the same time, demand for a wide variety of wireless communications services is increasing and redevelopment of the broadcast spectrum could help meet these demands over the longer term. Given the complexity of transitioning from NTSC to ATV, it is important to take steps up front to ensure that useable spectrum is recovered as soon as possible.

As addressed in Section I of these comments, Motorola recommends the Commission take the following steps to help speed spectrum recovery and make efficient use of this vastly underutilized resource:

- Make spectrum recovery an absolute requirement rather than an option in this proceeding.
- Identify contiguous block(s) of spectrum for redevelopment within which ATV channel allotments will not be made. There are a number of tradeoffs to consider in determining which block(s) to recover, and examination of these tradeoffs is needed in developing an allotment plan.
- Accelerate finalization of an ATV channel allotment plan, associated application filing window, and construction requirements for ATV transmission systems.
- Establish a date certain by which all TV receivers sold must have the capability to receive ATV transmissions, thereby speeding the transition from NTSC to ATV.

Currently, the private land mobile radio services utilize a small portion of the unused TV spectrum in 11 urban areas. Such sharing helps provide communications for the public safety, business and critical industry operations and makes effective use of what would otherwise be vacant spectrum. As addressed in Section II of our comments, the

Commission should ensure that the ATV channel allotment plan provides adequate protection to this shared use from both cochannel and adjacent channel ATV facilities.

The Commission also requests comment on a number of issues concerning the degree of flexibility broadcasters should have in using a new free ATV channel, requirements for cable must-carry of ATV channels, and the logistics of issuing ATV licenses. As addressed in Section III of these comments, we believe broadcasters should not be given free access to a 6 MHz channel under the guise of providing HDTV if in fact, the market for such services does not exist. Alternatively, the Commission should consider tying the degree of flexibility to compensation for use of the spectrum. Finally, Motorola is concerned that requiring cable operators to carry both NTSC and ATV channels during the transition stage will reduce cable operators' options to provide other competitive services as envisioned under the pending telecom legislation rewrite.

The benefits in this proceeding are likely to be delayed compared to those which accrue from many other Commission rulemakings. Therefore, Motorola does not view recovered broadcast spectrum as a substitute for more immediate Commission actions to provide spectrum for public safety, businesses, critical industries or consumer broadband communications. The steps recommended by Motorola in these comments, however, should help pave the way for much better use of the now valuable but vastly underused broadcast TV spectrum allocations.

I. Spectrum Recovery Should Be an Integral Part of This Proceeding

The public should have access to entertainment. No one argues that. The possible pipelines to deliver that entertainment, however, have changed drastically since over-the-air TV broadcast was allocated 400 MHz of spectrum back in the 1940's. For example, cable now passes 97% of the TV households and the number of households obtaining TV over cable has grown from only 13 % in 1975 to approximately 63% today. Small, cost-effective direct broadcast satellite receivers have gained consumer acceptance over the past two years. The pending telecom legislation holds the promise of even more options for consumers to obtain any number of services, including entertainment.

During this same time, U.S. businesses and consumers have become more and more mobile, increasing the demand for cost effective portable communications such as paging, dispatch and mobile telephone. This demand is fueled by both increased general consumer awareness of the value of "anytime/anywhere" communications and the growing number of situations in which more experienced users find portable/mobile communications essential in their day-to-day activities. Also, technology advances in Digital Signal Processors ("DSP's"), low current drain microprocessors, more efficient rechargeable batteries and low cost displays are converging to make such "anytime/anywhere communications" cost-effective for a broader array of users. These technology advances provide both efficiency increases in existing mobile spectrum and new applications which fuel the demand for additional spectrum.

Motorola therefore believes it is time to seriously revisit a 1940's era decision which dedicated over 400 MHz of prime VHF and UHF band spectrum for over-the air television entertainment. Instead, this spectrum could be used to help fight crime, manage our electric, petroleum, and transportation infrastructures, improve the efficiency of the nation's businesses, or help provide consumers with broadband access to services other than entertainment.

The past 50 years of history has established that such an allocation is extremely disproportionate. By the FCC's own estimates, on average only 80 MHz of this spectrum is used today for actual broadcasts in each market, with only 120 MHz used even in the top markets.¹ In other words, in the top markets broadcast TV is using only 30% of its

¹ FCC Notice at para. 87.

allocation for actual delivery of services to the public. Most of the remainder either lies fallow or is used as guardband. In the top 11 markets a minuscule portion of the broadcast allocation is used for private land mobile operation.

Such disproportionately excessive allocations for broadcast TV help maintain spectrum shortages in other areas. These shortages have an opportunity cost which will be borne by the public. The availability and corresponding cost of spectrum directly impacts the cost of introducing new and emerging wireless communications, especially those that require increased bandwidth such as fax, imaging and computer connectivity. In essence, higher costs play a significant role in denying or delaying access to such new services by small businesses, public safety entities and the general public.

Eight years ago, the Commission was poised to make more effective use of this underutilized resource by allowing additional land mobile sharing in the TV bands. Unfortunately, this effort became stalled based on the promise of High Definition Television (HDTV) being "right around the corner."

Given that the broadcast community has taken eight years to develop a standard for advanced TV systems, it is understandable that the land mobile community questions whether there really is a serious market demand for HDTV. In contrast, standards for personal communications service (PCS) systems were developed in industry with a similar degree of competitive participation in only 2 - 3 years and PCS operators are bringing systems online. One might conclude from these actions that while there is a real market demand for wireless communications services, a similar demand simply does not exist for HDTV. Motorola hopes this is not the case. It would be a shame to earmark such vast amounts of prime spectrum in the VHF and UHF bands for HDTV if in fact there are significant indications the market does not exist.

Further advances in semiconductor technology provide the capability for broadcasters to deploy more efficient and higher quality transmissions, as envisioned in this proceeding. The Grand Alliance standard is near completion. It is time to move forward.

It appears the Commission will devote significant spectrum possibly free of cost to broadcasters, apparently because it believes either there is a demand for ATV or that there are valid policy reasons to spur its implementation. Given the desire not to obsolete 200 million television receivers in use, we understand this reallocation cannot happen overnight. Accordingly, this proceeding is not likely to be an adequate substitute for other Commission actions needed to solve near term spectrum requirements. However, Motorola recommends the Commission take the necessary steps to ensure that ATV service is delivered to the public and that spectrum is recovered with the absolute minimal delay. Decisions reached over the next six months to one year will establish a path which could result in much better use of this now valuable but wasted resource. We recommend the following specific steps to help speed this process:

A. Spectrum recovery must be an absolute requirement rather than an option

It is understandable that broadcasters may want to hold onto both ATV and NTSC channels as long as possible. After all, prime spectrum is extremely valuable. Broadcast television stations may not charge "subscribers" directly, but it is clear that their value is very closely tied to an FCC license. UHF television station WNYC-TV in New York recently sold for \$207 million. According to the trade press, this value could be almost totally attributed to the license and associated 6 MHz of spectrum as the station appeared to have very few tangible assets and little brand identity. Holding both an NTSC and ATV channel of course would yield 12 MHz of spectrum, which by the above standard could be worth over \$400 million in New York. Throughout the country, TV licenses are valuable. Broadcasting and Cable magazine reports that 117 television stations have traded hands so far this year, at an aggregate price of over \$3.1 billion.

Given such a potentially strong incentive for broadcasters to hold onto both NTSC and ATV channels, Motorola recommends the Commission take definitive action at the outset to eliminate all doubt that spectrum will be recovered. In addition to specifying this in a rulemaking decision, Motorola recommends the Commission condition each construction permit and license to specify that authorization for operation on the NTSC channel automatically cancels by a date certain. However, the Commission should conduct statistically significant surveys periodically during the transition period to determine the percentage of television households that are capable of receiving ATV service. If the results of these surveys warrant, the Commission should then accelerate the recovery date, possibly giving advance notice, e.g., one year.

B. The Commission should identify contiguous block(s) of spectrum for redevelopment within which ATV channel allotments will not be made

In its Notice the Commission requests comments on the benefits of recovering a contiguous block of channels vs. spreading the recovered channels piecemeal throughout the broadcast TV band. It is Motorola's experience that technical conflicts are most common when systems of vastly dissimilar characteristics occupy adjacent spectrum. For example, television broadcast operates at powers much higher than land mobile. This dissimilarity has caused interference for land mobile systems operating just below 470 MHz from TV stations on channel 14 (470-476 MHz). Similarly, high powered TV stations on channel 69 (800-806 MHz) have caused interference to land mobile operations in the 806 MHz area. Such problems require a significant amount of resources and attention from all parties and some situations are just not solvable without severely limiting the operation of at least one of the parties involved. Therefore, Motorola believes it is in the best interest of all to minimize the potential number of "property line disputes" by recovering contiguous blocks of spectrum as opposed to piecemeal channels.

There are various tradeoffs to consider when determining which block of spectrum to recover. NTIA recently recommended that recovery of the high band VHF channels 7-13 (174-216 MHz) would be preferable to that of low band VHF channels 2-6 (54-72 and 76-88 MHz). NTIA's rationale was based on the erratic propagation conditions that can plague mobile operations in the low band VHF spectrum and on the close proximity of the high band VHF channels to spectrum used in the 138-174 MHz and 220-222 MHz bands for government and non-government land mobile operations, respectively.

On the other hand, cable systems are beginning to deploy equipment providing upstream capacity from the headend to the home, using the frequency range from 5-42 MHz. Ultimate use of the low band VHF channels might give cable operators increased flexibility to expand the cable upstream capacity, as spectrum in channels 2-6 may no longer be needed to deliver broadcast over the cable.

Limited land mobile operations already exist on a shared basis on TV channels 14-20 (470-512 MHz). Many of these operations are in support of public safety communications requirements. Further, land mobile systems are also prevalent at 406-420 MHz for government operations and 450-470 MHz for non-government use. Spectrum recovered from the lower end of the UHF TV band therefore could be easily used for land mobile on a cost effective basis.

Broadcasters have historically preferred VHF and lower UHF channels to those at the upper UHF band. For example, examination of licensing data for the top UHF channels 60-69 (746-806 MHz) shows only about 100 stations nationwide. These channels are also directly adjacent to mobile operations in the 806-821 MHz band. Recovery of this block of spectrum, therefore, may be an option which might be favored by both the broadcast and mobile wireless communities.

Motorola believes these and potentially other tradeoffs must be examined more fully before a firm recommendation can be made regarding which block(s) of spectrum are the most appropriate to recover. We recommend the Commission continue to accept input on this issue in preparation for the development of its draft ATV channel allotment plan to be proposed early in 1996.

C. The Commission should accelerate finalization of an ATV channel allotment plan, associated application filing window, and strict construction requirements for ATV transmission systems.

Previously, the Commission tentatively concluded that broadcasters should be given a total of six years within which to apply for and construct ATV facilities. This time period would commence with adoption of an ATV standard, or of a channel allotment plan, whichever is later.² Motorola believes this is excessive, given the policy desire to dedicate valuable spectrum for the delivery of advanced TV to the public.

Eight years have already elapsed since HDTV was promoted as “right around the corner” and such a construction date would translate to a full 15 years of delay in bringing this service to the public. Further, Motorola sees no practical reason why it should take 6 years from date of an allotment plan to construct an ATV facility. The allotment plan will identify which channel each existing full power broadcast station will receive for ATV operation. Wherever possible, it is envisioned that broadcasters will use existing sites to minimize additional costs. Therefore, a significant amount of the work required to authorize and implement construction and operation will occur up front.

Section 73.3598 provides TV broadcasters today 2 years within which to construct facilities. It is not apparent why even more time will be required to construct add-on ATV

² The allotment plan is expected to be finalized sometime in 1996.

facilities when new sites, and real estate for studios may not even be required in a number of situations.

Motorola therefore urges the Commission to compress the time for application processing and subsequent construction of ATV facilities. A six month period within which to request authorization, followed by no more than six months for Commission processing and grant and two years for construction would appear to be adequate. This would deliver ATV service to the public at the dawn of the new century.

D. The Commission should establish a date certain by which all TV receivers sold must have the capability to receive ATV transmissions, thereby speeding the transition from NTSC to ATV.

In general, Motorola believes in minimizing regulations and maximizing the consumer's choice and flexibility. A free market is usually much more effective than mandates on representing the choice of the public.

In certain circumstances, however, especially a chicken-vs.-egg dilemma posed by introducing a new consumer technology such as ATV, regulations are justifiable in order to "jump start" a market. Accordingly, we recommend the FCC require that televisions built after a given date certain must include ATV capability.

Further, we believe that all ATV televisions must have capability to receive and display signals in all ATV formats, including HDTV. This will ensure content creators and copyright holders of a consistent level of display quality, increase the economies of scale for HDTV sets and components and ensure that HDTV as a format does not "die".

When the Commission recently issued rules to reform the private land mobile bands below 800 MHz, it included requirements that all equipment type-accepted after certain dates be capable of certain benchmarks in efficiency. Motorola believes a similar approach could be used to ensure that TV sets capable of receiving ATV begin to be offered to the public without delay. This would help speed the penetration of ATV capable sets and provide increased certainty to help broadcasters attract the necessary capital needed to implement ATV transmission systems. In turn, recovery of the NTSC channel might be accelerated.

Motorola recognizes that smaller screen TV sets may show less improvement than larger screen sets in the implementation of ATV. Also, TV set manufacturers may not have the manufacturing capacity to begin sale of ATV in all sets at once. Therefore, we recommend that the Commission first require ATV capability in larger screen sets, followed by successive requirements that move down to smaller screen TVs.

Motorola recommends the Commission require that all sets with screens larger than 27 inch diagonal sold after January 1998 be ATV capable. This should give TV set manufacturers 2 years from finalization of the Grand Alliance standard to develop product and clear out existing inventory. In addition, this would ensure that at least some ATV receive capability would be in place for those broadcasters who chose to transmit ATV prior to required construction dates. If set manufacturers and broadcasters believe that incorporating ATV into sets smaller than 27 inch provides minimal or no real benefits to consumers, then we recommend the Commission require that those sets incorporate the capability to display standard definition converted from reception of an ATV signal. This will help obviate any purported requirement to extend transmission on the NTSC channels beyond a reasonable transition period to provide service to users with smaller sets.

II. The Commission Must Protect Existing Land Mobile Operations at 470-512 MHz.

Currently, private land mobile systems operate on certain channels within the 470-512 MHz spectrum on a shared basis with TV in 11 urban areas, as provided for in sections 90.301 - 90.315 of the rules. In most cities land mobile uses 2 of the TV 14-20 channels, except in New York and Los Angeles where public safety specifically has access to an additional channel and in Dallas, Houston and Miami where only one channel was made available for sharing. Clearly, in developing the ATV allotment plan, the Commission should protect land mobile systems operating under these sharing rules. Such protection will ensure that at least this small portion of the UHF TV band continues to be utilized effectively.

It is our understanding that some provisions are being made in a draft allotment plan for protection between cochannel ATV and land mobile systems. Further, Motorola believes previous occurrences of interference between land mobile and adjacent TV channel 14 or 69 operations signify the need to provide adjacent channel as well as cochannel protection to land mobile systems.

For current analog transmissions, FCC rules in section 73.687 (e) require that TV facilities on channels 14 or 69 limit emissions at the receive site of an adjacent channel land mobile facility experiencing interference to 17dBu. Further work is required to determine if this level of protection is adequate for situations involving ATV transmissions. As the attached Appendix shows, the out-of-band emissions of an ATV transmitter could be 10 dB greater than that experienced today with NTSC, given the same TV transmit power.

III. Requirements for usage of ATV channels should reflect the presumed public interest need for free TV spectrum

Despite the widespread use of cable, broadcasters have maintained that the public has an innate right to free over-the-air TV service. This public interest paradigm is then translated to infer that broadcasters deserve access to spectrum free of charge. Motorola does not necessarily draw that same conclusion. If the Commission is going to provide broadcasters with the gift of free access to spectrum, however, Motorola believes this warrants certain conditions on how this spectrum can be used. We discuss these conditions in this section of our comments.

A. Definition of Service/Flexibility

Motorola believes that the service offered on ATV channels should be responsive to the substantial benefit broadcasters are receiving by being given spectrum free of charge. We recommend the Commission require for example that a minimum of 8 hours per day of free, non-subscription video programming be broadcast in HDTV, and that all prime time shows over the ATV channel be free HDTV programs.

From the standpoint of market fairness, Motorola finds it difficult to support the use of ATV licenses for services that go beyond traditional broadcast television or ancillary and supplementary uses analogous to those allowed under our current regulatory regime. Recently, new narrowband and broadband PCS licensees spent approximately \$10 billion to gain access to spectrum to deliver new wireless services to the public. We believe it would be inherently unfair to those licensees for broadcasters to obtain spectrum free of charge and offer non-broadcast subscription services.

Along these lines, we believe any ancillary information or interactive services, be they free or subscription based, should be substantially related to the broadcast video content which is being carried by the license holder. For example, a broadcaster of a

football game on “free” SDTV could offer multiple views of the game via subscription basis, and could likewise offer relevant game statistics through on-screen text overlays. However, why should a broadcaster who has paid nothing for the spectrum offer a paging service through “leftover bandwidth” while transmitting a football game in SDTV rather than HDTV? If the entire channel is not required for broadcast purposes, then market fairness dictates that the spectrum be returned and reassigned.

B. Must Carry and Retransmission Consent

Motorola does not endorse Must Carry requirements for ATV signals. We believe it is an undue burden on the cable operator for the Commission to require coverage of both NTSC and an additional ATV signal. Of course, the cable operator would be free to carry the ATV signal if subscriber demand warrants. In particular, Motorola believes cable operators should be free to dedicate capacity for either delivery of ATV or for other competitive services envisioned by the pending telecom legislation rewrite.

IV. Summary

Decisions reached over the next 6 - 12 months in this proceeding will determine whether 400 MHz of television spectrum will be put to good use or continue to be vastly underused. Motorola encourages the Commission to take the steps enumerated in these comments to speed recovery of the spectrum. In addition, we encourage the Commission to protect existing land mobile operations at 470 - 512 MHz from interference. Finally, we encourage the Commission to leave cable operators with sufficient flexibility to choose which services to carry in response to market demand.

APPENDIX

ABSTRACT

The out of band emissions of an NTSC transmitter and an ATV transmitter have been compared for the same power transmitted. The average level of the ATV out of band emissions are 10 dB or more higher than the NTSC emissions on the low frequency side of the channel, and much higher than that on the high side. The subjective nature of the interference produced by the ATV emissions may be less objectionable than those from an NTSC signal, but this requires listening tests to determine.

INTRODUCTION

Land mobile systems currently share channels in the 470 MHz through 512 MHz band with NTSC Television. The interference from proposed ATV stations into land mobile receivers which operate in this band has not been measured. However, a spectral plot of the signal used in the Advanced Television Field Test Project has been made available, and it can be used to estimate the level of interference that may occur.

In this APPENDIX, we will compute the average power in the near adjacent channels outside of the 6 MHz bandwidth of an ATV channel, and compare that to the same parameter when an NTSC signal is being transmitted.

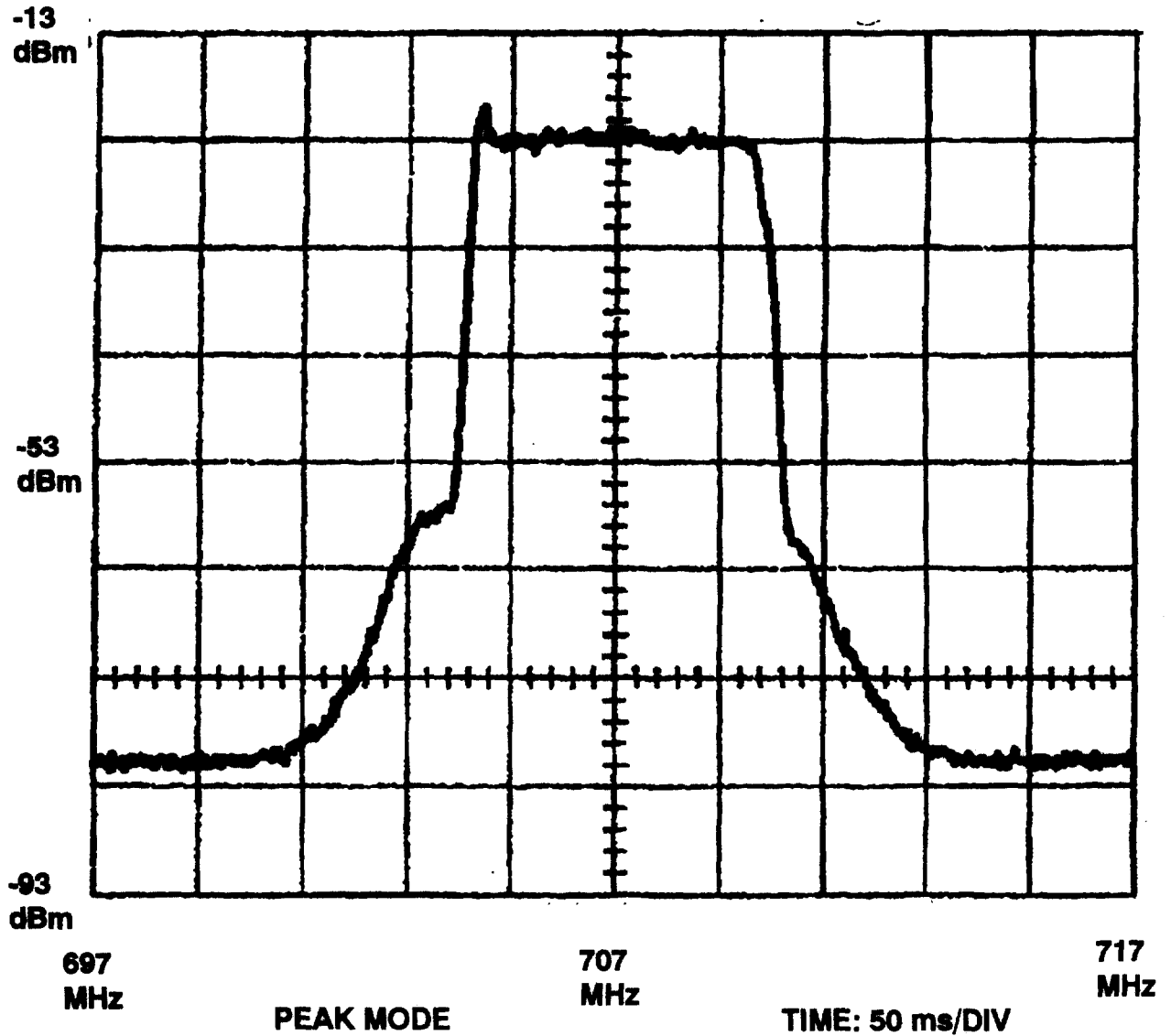
ATV ADJACENT CHANNEL INTERFERENCE

Figure 1 shows the measured spectrum of the channel 53 ATV signal, after the band pass filter, that was being tested this year in Charlotte, NC. The occupied bandwidth is reported to be 5.38 MHz, and the small peak on the left side is the pilot carrier. This spectrum was measured in the peak mode on a TEK 2712 spectrum analyzer. It is reported that the peak to average ratio is 6.5 dB, and for this analysis, we will assume that the signal is noise like. It is evident from inspection that the signal is approximately flat over the occupied bandwidth.

This signal was measured with a 300 kHz resolution bandwidth, but the relative difference between that and the signal measured with a 30 kHz resolution bandwidth will be assumed to be about the same. Thus, with a total radiated power of P_o Watts, the signal power within any 30 kHz bandwidth p , expressed in dB, will be:

$$p = 10 \log (30 P_o / 5400) = -22.55 + 10 \log (P_o)$$

The level of the flat spectrum is thus approximately 22.6 dB below the level of the total peak power. From inspection of the spectral plot, the out of band energy in the adjacent 30 kHz on the low side of the spectrum is 35 dB below the energy in the occupied bandwidth. On the upper side of the channel, the energy in the adjacent 30 kHz is about 30 dB below the energy in the occupied bandwidth.



707.00 MHz
-13.0 dBm
2.0 MHz/
300 kHz RBW

ATTN 18 dB
VF 3 kHz
10 dB/
M 707.04MHz
M -22.3 dBm

TIME: 08:22:05
DATE: 10-AUG-95

Note: Readouts
correspond to
waveform 'D'

Figure 1 Measured ATV spectrum

Thus, the energy in the adjacent channels is attenuated $22.6 + 35 = 57.6$ dB and $22.6 + 30 = 52.6$ dB below the total power on the right and left sides of the channel respectively. Assuming that the out of band emissions have the same peak to average ratio as the in band emissions (an assumption that must certainly be checked) the attenuation of the emissions from the peak power is the same as that from the average power.

NTSC ADJACENT CHANNEL INTERFERENCE

The spectrum in Figure 2 is an over the air measurement of the signal received from the Chicago, IL channel 32 which is transmitting an NTSC signal. This channel was chosen because it provides a strong signal at the location of the receiver, approximately 25 miles from the source, and hence maximizes the signal to noise ratio. The signal was received on a UHF corner reflector, transmitted through approximately 40 feet of coaxial cable, amplified in a Hewlett Packard 8447D wide band low noise preamplifier, and detected in the average mode in a Rohde and Schwartz PSA spectrum analyzer. The resolution bandwidth was set at 30 kHz, consistent with the FCC requirements in paragraph 73.687 (e) (4) (ii) for measurement of potential interfering adjacent channel emissions of channel 14 and 69 TV signals into a land mobile receiver.

Most of the power in this NTSC signal is contained within the picture carrier. The sound carrier is about 8 dB lower on this plot and the color sub carrier is about 38 dB below the picture carrier. The rest of the spectrum is even lower.

The power in the picture carrier thus represents approximately 90 % of the total power transmitted in the NTSC spectrum, and the carrier is therefore approximately 0.5 dB below the total power. From inspection of the spectrum on the low side of the channel in Figure 2, the out of band emissions are attenuated from 61 to 70.5 dB below the carrier depending on the exact frequency chosen. (The plot shows a level of -67.5 dB on the low side, some 3 dB above the noise. This is the sum of the powers of the signal and the noise, so the signal alone must be the same as the noise alone, or 70.5 dB below the carrier.) The attenuation from the total power transmitted is 0.5 dB more, or 61.5 to 71 dB. On the high side of the channel, the spectrum is clearly in the noise before going out of band.

The spectrum of other NTSC TV channels in the Chicago area were observed, and they produce out of band emissions that are of a similar magnitude to those of the channel 32 spectrum presented herein.



Date 08.Oct.'95 Time 22:16:19

Ref.Lvl
-10.00 dBm

Res.Bw 30.0 kHz [3dB]

Vid.Bw 30 kHz

CF.Stp 1.000 MHz

RF.Att Unit 20 dB [dBm]

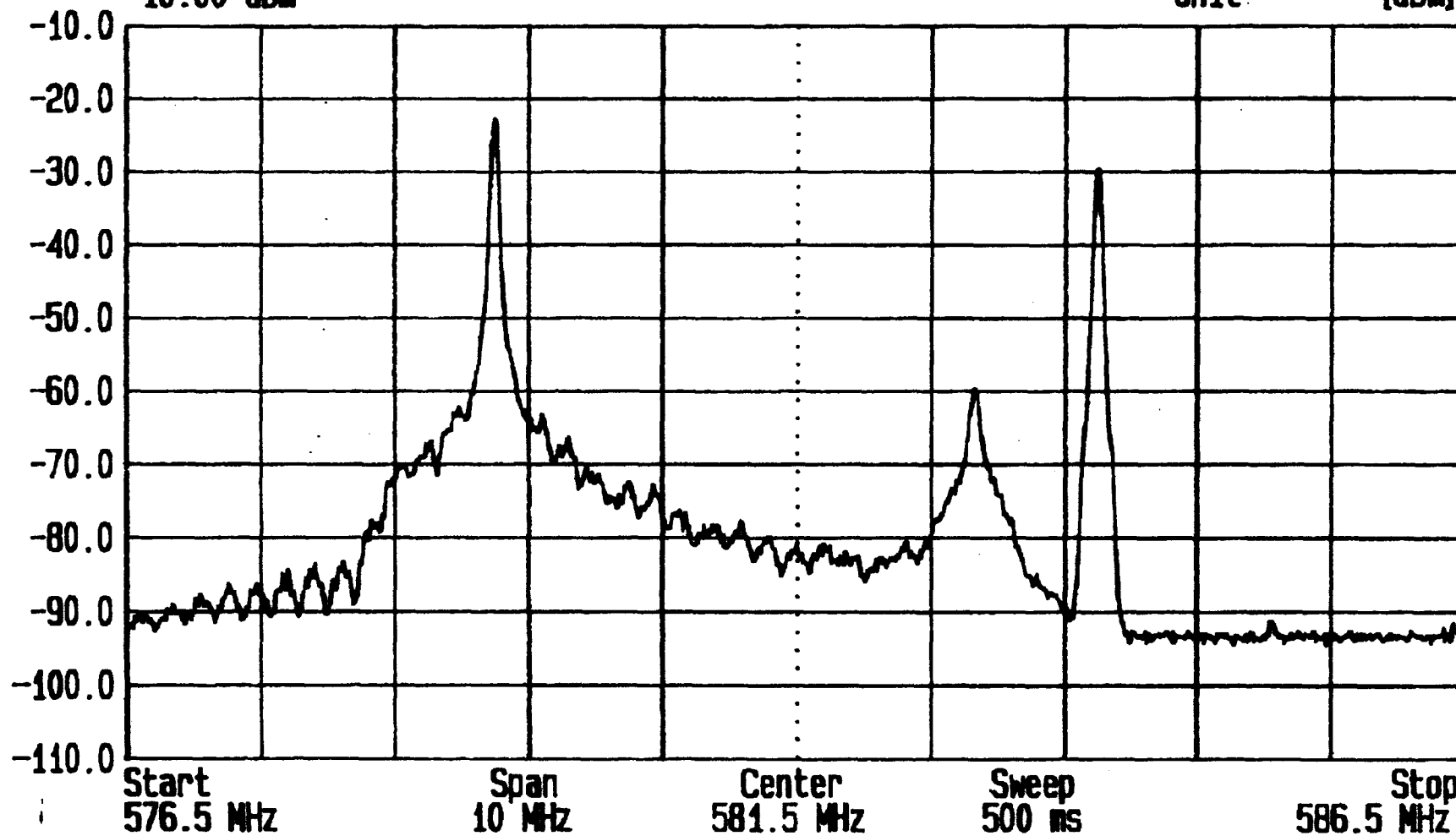


Figure 2 Spectral plot of NTSC Channel 32 taken over the air.

ATV AND NTSC INTERFERENCE COMPARED

The subjective nature of the interference of the two kinds of signals is impossible to determine without testing. However, it is expected that the ATV signal may be more noise like than the NTSC signal. And this may be less objectionable than the same average power NTSC signal with its 30, 60, 15,000 Hz and other repetitive components that can produce audible effects in the affected receiver.

However, it has been established herein that the out of band emissions in a 30 kHz bandwidth of the ATV test transmitter that was used in the tests in Charlotte NC is relatively higher than those of NTSC transmitters in service in the Chicago, IL area. The magnitude of the difference is of the order of 10 dB on the low side of the channel, and is more than the measurement capability on the high side of the channel.

CONCLUSION

For the same power transmitted, the out of band emissions of an NTSC transmitter are attenuated by 10 dB or more than those of an ATV transmitter. The subjective nature of the interference produced in a land mobile receiver must be determined experimentally, but it is postulated that the NTSC will prove to be worse than its ATV counterpart.

CERTIFICATE OF SERVICE

I, Tanya R. Mason, of Motorola Inc. do hereby certify that on this 20th day of November, 1995 a copy of the foregoing "Comments" was sent to each of the following by hand:


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